Sulcal Neuroanatomy and Relative Relationships using Spatial Gradients

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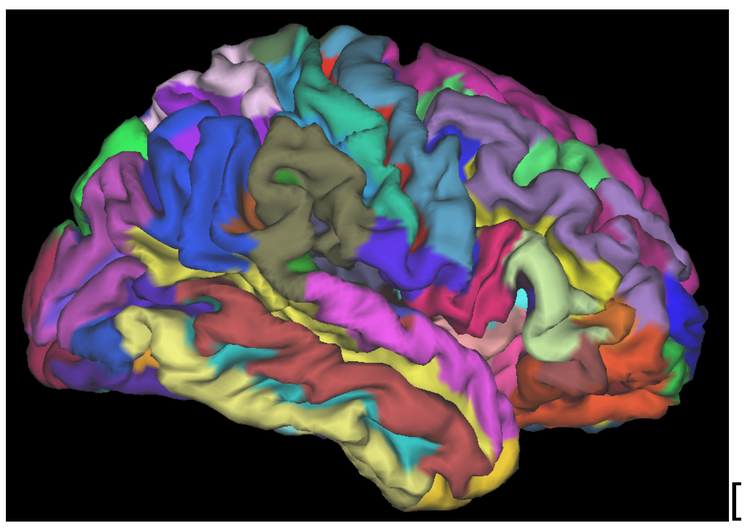
Objective: To characterise sulcal traits and relationships by means of spatial gradients. Our use of spatial gradients allows for the investigation of sulcal associations on structural MRI images. We localise, identify and relate sulci to examine inter-sulcal relationships, providing additional insight into cortical mapping.

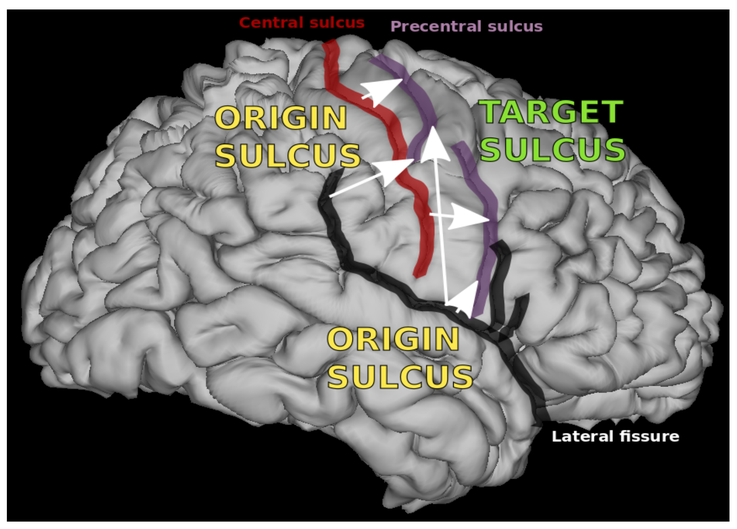
1 Cortical Mapping



[1]

Current atlases may struggle to account for **inter-individual variability** of sulcal characteristics.

2 How do we address this?



Cortical mapping based on assumption of a few **consistent sulci.**

Localisation of each sulcus based on **relative positions** to landmark sulci.

3 Methods

1. Sulci identified via the Destrieux atlas[1]
2. Compute the coordinate differences between origin and target sulci vertices
3. Translation into neuroanatomical terms: anteriority/posteriority and inferiority/ superiority
4. PDFs thresholded for anterior and inferior (>0.95) and posterior and inferior (<0.05)

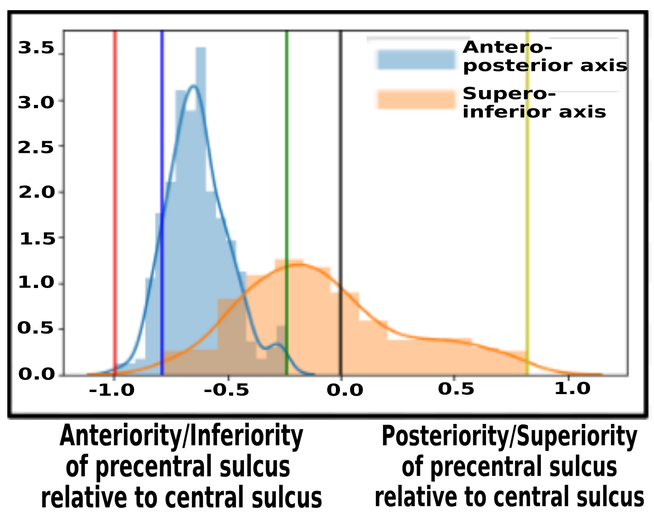


Figure 1: Probability density function depicting the relative coordinate differences of the vertices of the precentral sulcus relative to the central sulcus. The antero-posterior axis (in blue) refers to the difference on the y-axis plane, and the supero-inferior axis (in yellow) on the z-axis plane.

We applied the relative position terms to 589 subjects (53% female, age 29.3±3.28).

4 Results

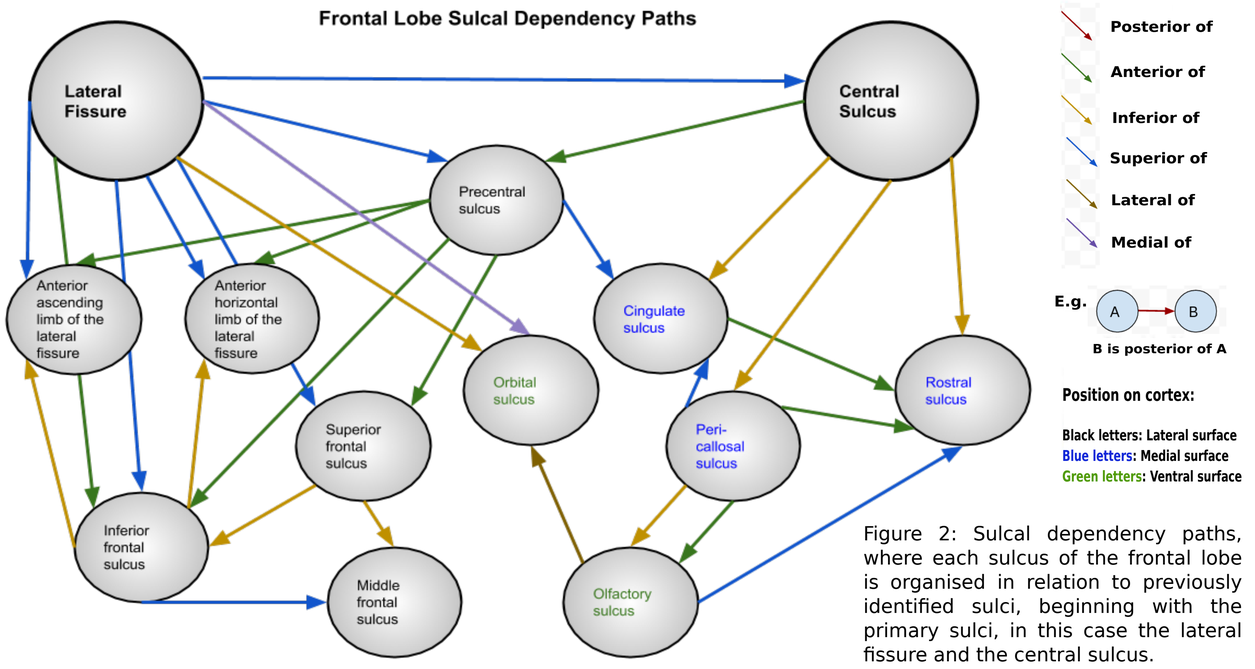


Figure 2: Sulcal dependency paths, where each sulcus of the frontal lobe is organised in relation to previously identified sulci, beginning with the primary sulci, in this case the lateral fissure and the central sulcus.

We took the significant sulcal relations and constructed dependency paths per lobe (see Fig. 2), whereby any sulcus can be found based on previously found sulci.

5 Discussion & Conclusions

Primary sulcal relations were consistent across hemispheres and subjects, mirrored by consistencies across many secondary sulci.

Our results reinforce our hypothesis of **localising sulci according to their spatial gradients** as a proof-of-concept study.

We have shown **how primary and secondary sulci relate to each other** and have quantified our findings as being **consistent in a large population**, thus providing additional insight into cortical mapping.

References

[1] Destrieux, C., Fischl, B., Dale, A. and Halgren, E. (2010). 'Automatic parcellation of human cortical gyri and sulci using standard anatomical nomenclature.' NeuroImage, 53(1), pp.1-15.

Acknowledgements:

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